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HEAD AND NECK LOADS AND MOMENTS DEVELOPED DURING TACTICAL AND ROTARY WING +Gz-STRESS

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Purpose. Neck injury risk may increase when aircrew wear head-mounted equipment during flight, however, maneuvering acceleration head/neck forces and moments have not been determined. **Methods**. Added weight and varying center-of-gravity (CG) effects were determined using an instrumented manikin at the Brooks centrifuge. A custom designed aluminum head fixture was developed to support the weights. A solid aluminum neck was used to prevent excess unrealistic head motion seen in previous studies. Data included centrifuge Gz, head acceleration (3 axes), head and C7-T1 point moment (My), compressive (Fz) and shear (Fx) forces. +Gz profiles (5s plateau) simulated helicopter (0.5G/s to +1.75 or +4Gz) and tactical aircraft capabilities (2G/s or 6G/s to +4,6,8,10,12 Gz). Two Gillingham simulated aerial combat maneuvers (SACM) (alternating plateaus with either +6Gz or +10Gz peak) were included. Impact of weight (3.5 to 6lb.), weight position (forward pitch and lateral planes), and onset rate were determined using ANOVA with a Fisher's LDS post-hoc test. Seven military helmet systems were also tested. **Results**. Head (H) and neck (N) forces, accelerations, and moments increased with increasing +Gz-load, weight and onset rate ($p<0.01$). Weights positioned laterally led to lower forces and moments when compared to forward pitch locations (Table I). SACM HGx, HGy, HFx, HMy and NMy differed from comparable 5s plateau values for all configurations, possibly due to more realistic motion effects. **Conclusions**. Effects of CG and +Gz-stress on head/neck loads and moments have been quantified.

TABLE I. Mean ± 1 sd NMy (in-lb.) and resultant neck force during plateau at 2G/s.

		NMy		NFxz	
Configuration	Weight (lb.)	+4Gz	+12Gz	+4Gz	+12Gz
Lateral	4.0	160±1	690±2	62±0.2	230±0.2
Lateral	5.5	177±1	752±2	70±0.1	250±0.2
60° pitch	4.0	181±1	768±2	65±0.1	233±0.2
60° pitch	5.5	245±1	987±2	71±0.2	250±0.2
Navy-T	3.0	177±1	736±2	64±0.1	228±0.2
Air Force-T	3.3	177±1	726±2	64±0.1	227±0.2
Navy-TDN	5.4	198±1	809±2	71±0.2	248±0.2
J-D	4.1	203±1	841±2	64±0.3	234±0.2

Helmet systems: T: tactical; DN: day/night with optics; J-D: prototype joint service display.